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10/815,932	04/02/2004	Kouji Matsuo	04329.2222-01	9409

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EXAMINER

RAO, SHRINIVAS H

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 09/11/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/815,932	Applicant(s) MATSUO ET AL.	
	Examiner Steven H. Rao	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 June 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3,4,6-11 and 21-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1,3-4,6-11, 21-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Response to Amendment

Applicants' amendment filed on June 21, 2006 has been entered and forwarded to the Examiner on June 28, 2006

Therefore claims 1, 6-8, as amended by the amendment and claims 3-4 and 9-11 as originally recited and presently newly added claims 22-23 are currently pending in the Application.

Claims 2,5, 12-20 have been cancelled.

Information Disclosure Statement

No further IDSs have been filed after the one filed on Jan 05, 2006 .

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 4,6 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Nakajima et al. (U.S. Patent No. 5,907,188 herein after Nakajima).

With respect to claim 1 describes a Nakajima describes a method of manufacturing a semiconductor device, (Nakajima title) comprising : forming a metal compound film directly or indirectly on a semiconductor substrate (Nakajima semiconductor substrate 1, metal film 3 on lfig. 1B) ; forming a metal-containing insulating film consisting of a metal oxide film or a metal silicate film by oxidizing said

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metal compound film (4) ; and forming an electrode on said metal-containing insulating film. (Nakajima figs. 3A to 3E) wherein an insulating film selected from a silicon oxide film, a silicon nitride film and a silicon oxy nitride film is interposed between said semiconductor substrate and said metal compound film. (Nakajima M-oxide , z-nitride). before forming said metal-containing insulating film by oxidizing said metal compound film. (Nakajima figs. 3A to 3E, 4 formed before 6).

With respect to claim 4 Nakajima describes the method of manufacturing a semiconductor device according to claim 1, wherein formation of said metal compound film and formation of said metal-containing insulating film by oxidation of the metal compound film are repeated a plurality of times. (Nakajima col. 9 lines 62 to col. 10 line 6).

With respect to claim 6 Nakajima describes the method of manufacturing a semiconductor device according to claim 1, wherein said metal compound film is selected from a metal nitride film, an oxygen-containing metal nitride film, a silicon-containing metal nitride film, a metal nitride film containing both oxygen and silicon, a metal carbide film, an oxygen-containing metal carbide film, a silicon-containing metal carbide film, a metal carbide film containing both oxygen and silicon, a metal carbonitride film, an oxygen-containing metal carbonitride film, a silicon-containing metal carbonitride film, and a metal carbonitride film containing both oxygen and silicon. (Nakajima col. 15 line 65- WSiN film i.e. metal nitride film)

With respect to claim 7 Nakajima describes the method of manufacturing a semiconductor device according to claim 1, wherein said metal compound film contains

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at least one metal selected from titanium, zirconium, , hafnium, tantalum, niobium, aluminum, yttrium and cerium (Nakajima claim 8).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3 ,8-11 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakajima as applied to claims 1-2, 4-6 above and further in view of Hu (U.S. Patent No. 5,962,904, hereinafter Hu).

With respect to claim 3 Nakajima describes the method of manufacturing a semiconductor device according to claim 1 Nakajima does not specifically describe wherein said metal compound film has a thickness not larger than 5 nm.

However Hu, a patent from the same field of endeavor describes in col. 3 lines 50 to col.4 line 28 wherein said metal compound film has a thickness not larger than 5 nm to form a barrier film having a resisstivity sufficiently low to allow the gate to function efficiently.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Hu's thickness of the metal compound layer in Nakajima's device. The motivation to make the above combination is to form a barrier film having a

resistivity sufficiently low to allow the gate to function efficiently. (Hu col. Lines 35-40).

With respect to claim 8 Nakajima describes the method of manufacturing a semiconductor device comprising forming a metal compound film directly or indirectly on a semiconductor substrate (Nakajima semiconductor substrate 1, metal film 3 on I fig. 1B) ; forming a metal-containing insulating film consisting of a metal oxide film or a metal silicate film by oxidizing said metal compound film (4) ; and forming an electrode on said metal-containing insulating film. (Nakajima figs. 3A to 3E) wherein said metal-containing insulating film consists of a plurality of first insulating regions formed of pairs containing a metal oxide of a metal element contained in said metal compound film a second insulating region formed of an amorphous insulating material in a region (Hu layer 14-crystalline) and except the first insulating regions. (Hu layer 18 amorphous)

With respect to claim 9 Nakajima describes the method of manufacturing a semiconductor device according to claim 8, wherein said metal compound film contains a metal element forming said metal oxide and silicon, said first insulating region contains a crystal of said metal oxide, and said second insulating region contains silicon, oxygen and a metal element forming said metal oxide. (Hu layer 14 is crystalline and layer 18 is amorphous).

With respect to claim 10 Nakajima describes the method of manufacturing a semiconductor device according to claim 8, wherein said metal compound film contains a first metal element forming said metal oxide and a second metal element differing from said first metal element (Hu col. 4 lines 5-11), said first insulating region contains a crystal of said metal oxide, and said second insulating region contains oxygen and

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said second metal element. (Hu col. 4 lines 5-11).

With respect to claim 11 Nakajima describes the method of manufacturing a semiconductor device according to claim 8, wherein said metal compound film contains a metal element forming said metal oxide, said first insulating region is formed of crystal grains of said metal oxide, and said second insulating region is formed of an amorphous region of said metal oxide. (Hu col.. 4 lines 5-11 wherein the layer comprises both tungsten silicon nitride and titanium nitride similar to Applicants' specification paras 0252 and 0266, also shown in Figs. 7a and 8 B wherein insulating film has insulating regions 71/72 or both and layer 14- crystalline and layer 18 amorphous, Nakajima 3-tungsten, 4-oxide) .

Presently newly recited Claims 21 (repeats the steps of claim 3 and is rejected for reasons set out under claim 3 above) , similarly claim 22 repeats the steps of claim 6 and is rejected for reasons set out under claim 6 above, and further claim 23 repeats the steps of claim 7 and is rejected for reasons set out under claim 7 above.

Response to Arguments

Applicant's arguments filed on June 21 , 2 006 have been fully considered but they are not persuasive for the following reasons :.

Applicants' contention that Nakajima fails to disclose the step of claim 1 " forming a metal –containing insulating film consisting of a metal oxide film or a metal silicate film by oxidizing said metal compound film" is not persuasive because Nakajima describes the oxidization of metal film (4, of refractory metal is preferably formed of at least one

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selected from a group of Mo, W, Cr, Zn and Co, etc.) . which is oxidized to form metal oxide as shown and describes in at least figures 2, 9 and 16 etc. (see also description of fig.2 reproduced below).

FIG. 2 is a diagram showing the oxidation temperature 35
dependency of the film thickness of the oxide film 4 (with
WN₂) shown in FIG. 1B in comparison with the prior art
(without WN₂);

Therefore Nakajima also describes oxidizing a metal compound to produce at least a metal oxide .

Therefore Nakajima anticipates all the presently recited limitations of claim 1.

Applicants' contention with respect to the 103 rejections that :

(a) repeat the above contention that Nakajima alone or in combination with Hu

Any inquiry concerning this communication or earlier communications from the fails to disclose the step of claim1 " forming a metal –containing insulating film consisting of a metal oxide film or a metal silicate film by oxidizing said metal compound film" is not persuasive because as shown above Nakajima shows /describes this limitation and further as the primary reference discloses this step it is not necessary for the secondary reference to repeat the teachings of the primary reference.

(b) Nakajima and Hu fail to teach the presently newly added limitation " each of said first insulating regions is formed in said second insulating region. " is not persuasive, because firstly this limitation was not previously recited and it is not understood how Applicants' can conclude that the Examiner's previous rejection (reproduced below):

"With respect to claim 8 Nakajima describes the method of manufacturing a semiconductor device according to claim 1, wherein said metal-containing insulating film

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consists of a plurality of first insulating regions formed of pairs containing a metal oxide of a metal element contained in said metal compound film (Hu layer 14-crystalline) and a second insulating region formed of an amorphous insulating material in a region except the first insulating regions. (Hu layer 18 amorphous)" is applicable to then non existing limitations namely "each of said first insulating regions is formed in said second insulating region. " (emphasis supplied).

Secondly Hu col.. 4 lines 5-11 (reproduced below) wherein the layer comprises both tungsten silicon nitride and titanium nitride similar to Applicants' specification paras 0252 and 0266, also shown in Figs. 7a and 8 B wherein insulating film has insulating regions 71/72 or both and layer 14- crystalline and layer 18 amorphous, Nakajima 3-

5 metal for purposes of the invention described herein includes but is not limited to titanium, chromium, tantalum, platinum, tungsten and zirconium, and also includes molybdenum. $RmSi_3N_4$ can be comprised of both tungsten silicon nitride and titanium silicon nitride. For example, a preferred
 10 embodiment uses a diffusion barrier substantially composed of tungsten silicon nitride (WSi_3N_4). An electrically conductive layer 20 is disposed over and in contact with tungsten, 4-oxide) .

Therefore all of Applicants' arguments are not found persuasive and all claims 1,3-4,, 6-11 and 21-23 are Finally rejected.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven H. Rao whose telephone number is (571)272-1718. The examiner can normally be reached on 8.00 to 5.00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Fahmy Wael can be reached on (571) 272-1714. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

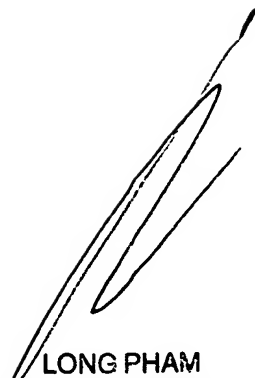
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Steven H. Rao

Patent Examiner

August 23, 2006.



LONG PHAM
PRIMARY EXAMINER